2002

Girls, computers, and the internet : an end to the gender gap?

Cate Humby-Hoff
San Jose State University

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

GIRLS, COMPUTERS, AND THE INTERNET:

AN END TO THE GENDER GAP?

A Thesis

Presented to

The Faculty of the School of Journalism and Mass Communications

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

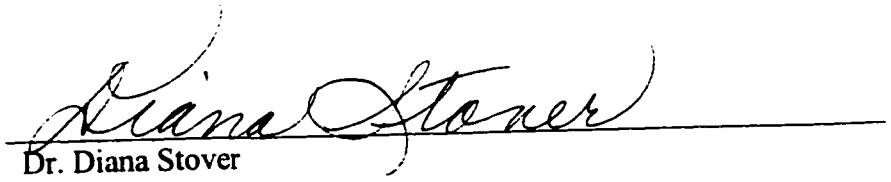
Cate Humby-Hoff

May 2002

UMI Number: 1408792

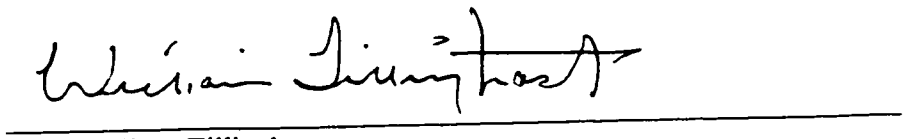
ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

APPROVED FOR THE SCHOOL OF JOURNALISM AND MASS COMMUNICATIONS



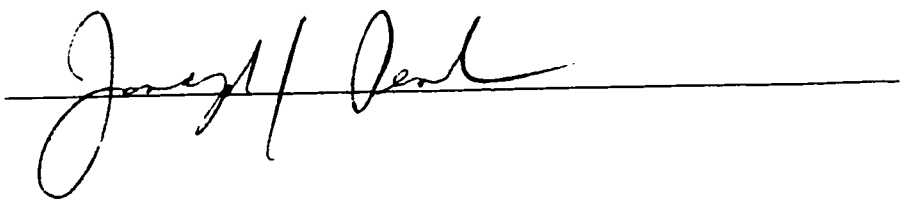
Dr. Diana Stover

Dr. Kenneth Plowman



Dr. William Tillinghast

APPROVED FOR THE UNIVERSITY



ABSTRACT

GIRLS, COMPUTERS, AND THE INTERNET: AN END TO THE GENDER GAP?

by Cate Humby-Hoff

This study updates earlier research on the computer gender gap and extends it to include the Internet. Its purpose is to determine how the Internet has changed girls' perceptions, opinions, access, and use of computers and technology. A purposive sample of students from a high socioeconomic area was studied. Three complementary research methods were used: participant observation, focus groups, and survey research.

Relatively few differences were found in this study between girls' and boys' opinions, perceptions, and use of computers and the Internet, suggesting that the gender gap in computer use may be disappearing. The findings indicate that girls and boys use computers and the Internet in similar amounts, have similarly positive opinions about these technologies, and have equal access to them. These findings contrast with earlier studies, which found that males had significant leads in these categories. The study did find gender differences in the perception of computers.

ACKNOWLEDGEMENTS

I would like to acknowledge Dr. Diana Stover for her guidance in helping me develop and complete my thesis. Her continual encouragement, support, and patience were invaluable. I admire her dedication and passion to the field, and feel fortunate to have had her as my main advisor to guide me through this process.

This thesis also could not be completed without the guidance of Dr. Kenneth Plowman and Dr. William Tillinghast. I appreciate all their time and effort reviewing my drafts and offering their suggestions.

DEDICATION

I would like to dedicate this thesis to the two most important people in my life. My husband, Paul Hoff, gave me the opportunity to pursue my master's degree. His constant support, love, and help with editing made this possible for me. Without him, this thesis would never have been completed.

I would also like to dedicate this thesis to my mother, Carmel Gannon, who had so little so we could have so much. Her sacrifice and endless encouragement helped shape me into the person that I am.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

The introduction and adoption of the personal computer, and more recently, the Internet, have caused radical changes in the way people live, work, and play. These innovations have been responsible for changing the nature of the economy and creating entirely new industries. The number of Internet-related jobs doubled from 1.25 million to 2.5 million from 1998 to 1999 (Edwards, 2000). Demand and rewards for workers in the technology industry have been great, but the opportunities have not been equally available to all segments of the population. Employees who have reaped the most benefits are those who had the greatest knowledge about, and comfort with, computers and technology.

The adoption of computers is far from balanced, and not all segments of the population have had access to or have learned about computers at the same time. One of the more notable inequities has been the disparity in the number of men versus the number of women who use computers for recreational purposes.

Studies on personal computer (PC) usage indicated that women were significantly less likely to use computers than men, possibly limiting their opportunities in this new economy. However, few studies have looked at gender differences since the Internet entered the mainstream. Since PCs are radically changed by the introduction of the Internet, the gender issue needs to be re-examined to understand what impact it may have had on women's adoption of technology and how it might be used to close the existing gender gap.

The diffusion of innovations theory (Rogers, 1995) helps explain how a new invention or technology is adopted by society. The theory suggests that not all segments of society adopt an innovation simultaneously; rather, adoption occurs in five waves based on an individual's willingness to innovate or accept innovation. The diffusion theory is useful in examining the adoption process for computers.

The use of personal computers followed the diffusion model: This new technology was adopted at different times by different segments of the population. In the beginning only academics and the scientific elite used PCs, but over time, as technology improved and prices fell, computers were adopted by a greater percentage of the population. The market is fast approaching what Rogers describes as a critical mass: the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining (Rogers, 1995, p. 13).

When the adoption of computers is analyzed by gender, the figures reveal an extremely important adoption gap with men using computers more than women. Research showed that outside of the workplace women used computers less than men. Since the mid-1980s researchers have tried to determine what factors caused this phenomenon. Studies found that a variety of behavioral and social factors help explain why women do not use computers as much as men.

The Internet has transformed computers into a new mass medium that allows two-way, global communication. The introduction of the Internet has transformed computers from stand-alone devices to nodes on a worldwide network that serves as a gateway to incredible amounts of information. Although the Internet was invented to share

computing resources within the government and universities, as the Internet diffused into society, it was reinvented. Internet-connected computers are no longer isolated machines and users are no longer restricted to the information stored on their hard drives. The computer has become a communications tool that allows people to engage in instantaneous and two-way communication.

The goal of this study is to determine if women's access, use, perceptions, and opinions of computers and technology have changed since the adoption of the Internet into the mainstream. Specifically, this study explores how girls are adopting the Internet to see if the Internet is changing their perceptions, opinions, access, and use of computers and technology. To research this question, a purposive sample of students in Palo Alto, a high socioeconomic area, was selected because the diffusion of innovations theory suggests that higher socioeconomic status and a propensity to be innovative appear to go hand in hand. Three complementary research methods were used to study this population: participant observation, focus groups, and survey research.

The introduction of the Internet has created an opportunity for researchers to revisit earlier studies to see if the gender gap that was apparent during the early-adopter stage for computers exists on the Internet today. Because of the radical differences between stand-alone and Internet-connected PCs, it is possible that the reasons women did not adopt personal computers are no longer valid when applied to women using Internet-connected computers. The functionality and features of the Internet may be encouraging women to use computers when they would not have used them before.

Chapter two provides a discussion of the current research on how new technologies are adopted and an overview of the computer gender gap to provide context for this study. Chapter three is an outline of the methods used to determine how the Internet might impact earlier results. Chapter four provides a summary of the results of the field research, and Chapter five contains the conclusions drawn from these findings.

CHAPTER TWO

LITERATURE REVIEW

This first part of this literature review presents an overview of the diffusion of innovations theory, which is a theory from the field of mass communications that is used by this study as a framework for examining the impact of the Internet on the computer gender gap. The second part looks at earlier research on the computer gender gap and suggests reasons why the adoption of the Internet makes it necessary to update these earlier studies.

The Diffusion of Innovations Theory

In his book, *The Diffusion of Innovations* (1995), Rogers provides an excellent framework for understanding how new technologies are adopted in society. Rogers divides people into five categories, and orders them according to their likelihood of adopting new technologies. He postulates that members of each of these groups will adopt a new innovation sequentially. For example, members of the second group are not expected to begin using a new invention until the majority of the members of the first group have adopted it and so on through all five groups. Using Rogers' framework, it is possible to trace the adoption of a specific new technology through these groups, which provides insight into the relative pervasiveness and maturity of the invention in question at any point in time.

Rogers calls the first adopters of a new invention or technology *innovators*. In many cases it is members of this group who are responsible for turning a new technology into a usable product. This group is characterized by the obsession to innovate, the

financial resources to take risks, and the ability to work out the complex technical details that often accompany the early form of a new technology.

The second group is known as the *early adopters* and consists of the trendsetters who influence later groups to use the technology.

The third wave is known as the *early majority*. This group is characterized as adopting new ideas just before the average member of society.

The *late majority* is the fourth group that is characterized as being more skeptical about innovation. The late majority waits until most others have adopted an innovation before they try it. Frequently it takes economic need or pressure from their social circles for members of this group to try a new technology or invention.

The final group to take up a technology is the *laggards*. Members of this group are extremely hesitant to change their way of doing things and will only take up a new technology if it is absolutely necessary to do so.

Diffusion of Personal Computers

The diffusion of innovations theory is useful in tracing the movement of personal computers into the mainstream. The first electronic computer, known as the ENIAC (Bellis, 2000), was invented in 1946 and scientists were the primary users. The first innovators to take up computers were computer scientists, engineers, and academics who enjoyed working with technology. They had previous experience using technology in their jobs and were not intimidated by technology or its complexity.

It was not until 1974 that the modern computer revolution began in earnest, when the first personal computers, including the Altair, showed up (Bellis, 2000). The first

generation of these personal computers were typically available as kits, which meant that their users no longer had to be computer scientists to use them, but merely had to have some familiarity with electronics. It was this introduction of personal computers that moved computer usage from the innovators to the early adopters. These early computers attracted hobbyists and experimenters who truly enjoyed playing with the technology. Rogers (1995, p. 243) noted that "computers were perceived to be complex [by new users] and this was a negative force in their rate of adoption."

The negative experience of the second wave of users meant that it took a long time for computers to be adopted by the general population. In 1984, 10 years after the first personal computers were introduced, the United States Census Bureau (1997), reported that only 8% of the U.S. population had computers.

By the early 1980s, significant improvements in the design and interface of computers helped computers expand from the academic and research fields to become a technology that could be used by the early majority of users. With the introduction of the IBM PC in 1981 and associated applications, such as the Lotus 1-2-3 Spreadsheet program, the computer began to leave the realm of the hobbyist, and be taken up by businesses that could use the power of these programs (Bellis, 2000). But it was not until the introduction of the Macintosh in 1984, which was quickly followed by the introduction of Microsoft Windows in 1985, that computers began to attract mainstream attention. The new design replaced a hard-to-understand interface, which required memorizing difficult combinations of characters, with a graphical interface that made computers more accessible to, and useable by, a much larger segment of the population

(Sanford, 2000). The United States Census Bureau (1997) indicated that, by 1993, personal computers were used by 15% of the population.

By the late 1990s, computers had been adopted by the late majority and had diffused into the mainstream, with all groups except the laggards fully accepting the technology. Computers reached what Rogers (1995) described as a critical mass, which is achieved when enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining. According to the United States Census Bureau (1997), ownership of personal computers was estimated to have increased to 37% of all American households by 1997. McWilliams (1999) wrote in 1999 that the falling price and sales of personal computers illustrated that the market was reaching its saturation point, a clear indication that personal computers are fully adopted by the mainstream.

Gender Gap Research

Although Rogers' (1995) theory appears to indicate that computers have become an innovation used by the masses, data on the population as a whole hides an extremely important adoption gap. When the use of computers is examined along gender lines, research suggests that women may not use computers as often as, or in the same way as, men. In 1994 the United States Census Bureau (1994) looked at the use of computers and found that:

> Males consistently used computers more than females except at work. Men were more likely to have and use a home computer than were women; they were also more likely to use a computer at school. Men were more likely to have and to use a home computer and to use a computer at college. (p. 2)

Later, in 1999, the United States Census Bureau (1999) found similar differences still existed between the genders:

> There was no difference between adult men and women in the level of overall computer use. However, there are probably major differences across locales [work and home], which act to mask the estimates that consider use in all places. (p. 9)

Since the mid-1980s, researchers have conducted studies to determine why women used computers less than men. Researchers looked at all facets of this issue, and explanations for the differences fell into three main areas: First, some researchers attributed the different rates of adoption of computers to learned behavior; second, other researchers blamed barriers on the computer industry itself; and, finally, other researchers suggested that some aspects of women's psychology are innately different from men's, which impacts the way the two groups react to computers.

There are several studies suggesting that women use computers less because of learned behavior. The negative messages that society sends to women about technology have been implicated as one of the causes of women's slow adoption of personal computers. Pearl et al. (1990) found that society communicates that computers are not appropriate for women. Wilder, Mackie, and Cooper (1985) found that the majority of both sexes agreed that the computer was more appropriate for men than women, and that men at all ages liked computers better than women did.

Researchers have found that a woman's opinions of computers and technology begin forming in early childhood and these perceptions make it more likely that, from a very young age, women will avoid learning about computers and technology. Newman,

Cooper, and Ruble (1995), who studied gender differences in attitudes toward computers, found that women believe, from an early age, that computers are not appropriate for their gender.

Children learn what behaviors and attitudes are considered acceptable for their gender from the culture in which they live and may be vulnerable to these gender-based messages about computers. Kohlberg (1966) found that, once children understand their sex and realize that their gender is fixed, they are motivated to adopt the behaviors and attitudes deemed appropriate for that sex. Gender has also been found to affect the types of activities and objects children see as appropriate for their gender (Libert, McCall, & Hanratty, 1971).

The second reason researchers indicated that women were not using computers was because of barriers created in the computer and computer software industry. Research suggests that the software industry has failed to serve women's interests and needs, and that this has had a direct impact on the slow rate at which women have adopted personal computers. Studies examining the software available for work and recreation have consistently found that there is a lack of software that addresses a female's interests and needs, which may cause women to adopt computers slower than men. In a study looking at the representation of women in computer clip art, Dyrud (1997) found that women were represented in 5% of the clip art reviewed, despite the fact that women constitute more than 50% of the U.S. population. Men were depicted more often as high achievers, such as dentists, doctors, and managers. In contrast, women were represented as secretaries, mothers, nurses, and teachers.

The lack of software targeting women deters them from using the computer as a recreational tool. Recreational use has been found to be an important step in developing the interest, experience, and confidence that is necessary to successfully use technology. Lack of such use of a technology may have a significant negative impact on a group's adoption of computers. Two studies done by Keisler, Sproull, and Eccles (1985) found that children who play computer games are less inhibited by technology than those who don't. In a complementary study, they found that first-year college students who had high scores in high school computing courses also played computer games for fun.

Even educational software fails to engage women's interests. In a study looking at the characteristics of educational software, Hess and Miura (1985) found that the majority of educational software is developed on male themes such as adventure and violence. When researchers compared programs written for men to those for women, they found that software written for men had a more competitive tone. When a similar analysis was carried out on programs written for students of both genders, Huff and Cooper (1987) found that the majority of software was written with a male user in mind.

Lack of access to computers early in life may also be to blame for women's slower adoption of computers. Early experiences with technology help people become more comfortable in choosing a career or a degree in a technology-related area. Sutton (1991) found that, because women are less likely to use computers outside of school, they enter the classroom with less computer and technology experience than men. Hess and Miura (1985), in their study on enrollment in computer camps and classes, found that "three times as many men as women were enrolled in the total sample. The ratio of

males increased with grade, cost of program, and level of difficulty of course offerings" (p. 193). Some of the reasons cited for these differences were parental encouragement, a lack of software targeting women, and the public stereotype of computers and their close relationship with science, math, and engineering. By not participating in computer camps and clubs, or using computers as a recreational toy, women are missing out on important informal forms of computer training and experience, making it less likely that they will choose to work with technology in the future.

The male orientation of computer culture has also been found to impact women's uptake of computers. Keisler et al. (1985) found:

> Computing is more than a set of skills. It is embedded in a social system consisting of shared values and norms, a special vocabulary and humor, status and prestige ordering, and differentiation of members and non-members. In short, it is a culture. (p. 453)

Hawkins (1985) proposed that women who choose to work in the computer industry feel some discomfort with the culture of the industry and are therefore less represented in the industry than men. Pearl et al. (1990), in a discussion on computer hackers, suggested that the computer science culture is likely to have a negative effect on how many women choose a career in computer science later in life. Frenkle (1990) wrote that women are not comfortable in a field that encourages "highly focused, almost obsessive, behavior as the key to success" (p. 4). The male-orientation of computer culture was found to be alienating to women (Keisler et al., 1985). Even in non-technical industries, Gutek and Bikson (1985) found that "professional women have been found to feel less entitled than men with respect to access to computer equipment, learning support, work impacts, and decision-making capability" (p. 134). Hawkins (1985) found

that this male bias even shows up in computer trade publications, which were found to downplay the role of women in technology and not represent women in the same types of powerful positions as men.

The third reason that researchers have used to explain why women and men react differently to computers, and hence have different rates of adoption, is the idea that some aspects of a woman's psychology are innately different from a man's.

A woman's opinions and feelings can affect her success in utilizing technology. Women have been found to regard technology differently from men; they tend to look beyond the machine to its social function, while the masculine view focuses more on the machine itself (Brunner & Bennett, 1998). Also, the context in which women are introduced to computers can impact their perceptions about them. Hawkins (1985) found that introducing computers as a subject closely aligned to math and technology had a serious negative educational consequence for women. Learning about computers in this way led women to believe that one must be mathematically talented to work with computers, even though this may not be accurate. In contrast, when technology was presented as a means to an end, for example as a tool for in-depth research or for creating animation, women were as likely as men to find computers appealing (Garrubbo, 1998). This finding suggests that women might be more interested in computers when they are presented as a useful, time-saving tool than when they are presented as a recreational toy that does not help them in their day-to-day lives.

Women's perceptions and opinions of technology are evident in their computer behavior. Research has found that women act more helpless when using technology than

men. Women are less likely to fix a broken computer than men (Brunner & Bennett, 1998). If a woman experiences trouble using a computer, she is less likely to stick to the task than her male counterpart and, if she successfully completes a task using a computer, she is less likely to attribute her success to her own doing. Moreover, women have been found to look at their achievements when using technology in a self-defeating way. Ryckman and Peckham (1987) found that women more typically attributed their success to uncontrollable factors such as luck, and when they didn't succeed, they were more likely to identify factors such as task difficulty or ability as the causes. Women also tend to show a learned pattern of helplessness and have lower expectations for success (Huber & Podsakoff, 1987).

Overall, researchers identified a variety of reasons for the differences in male and female computer use. Since today's children will be tomorrow's adults, examining the younger population can provide a valuable window into future trends. Do these differences in computer use, opinions, and perceptions exist for children as well as adults?

Computer Access and Use Among Children

Early research found differences in girls and boys access to computers and the Internet. By the early '90s this began to change and education was identified as a driving force in helping to provide access to computers. Research found that children's opinions and perceptions lead those of the adults, and this might suggest that the gender gap in computer adoption could first disappear in younger populations.

As with studies of the general population in the early 1980s, gender and socioeconomic status were found to impact who had access to computers. Girls were less likely to have access and use computers when compared to boys (Attewell & Battle, 1999; Swadener & Jarrett, 1986; Sutton, 1991), and boys were more likely to have access to a home computer than girls by a ratio of 3:2 (Wilder et al., 1985). Socioeconomic status was also found to affect student access to computers.

Low socioeconomic status schools were about half as likely as high socioeconomic schools to have microcomputers (Becker, 1983), and even when they had computers, they offered a less favorable student-computer ratio (Rocheleau, 1995).

Boys were more likely to be the main users of computers at home and at school. Research found that girls use computers less (Times Mirror, 1994) and are less likely to play with computers in their spare time when compared to boys (Culley, 1988). In a study looking at heavy user groups, the gender gap was even greater (Harris, 1999). Another study that looked at the attitudes of first graders toward computers, asked students who uses the computer the most in their family (Nicholson, Gelphi, Young, & Sulzby, 1998). Overwhelmingly, boys were more likely than girls to identify themselves

as the primary computer users and to consider themselves as the owner of the home computer. Girls were more likely to name their father or parents as the most frequent users of the home PC.

A gender gap was also found in the number of female students who enroll in computer courses in schools. Becker and Sterling (1987) found that, in elementary school through high school, girls were less likely than boys to take computer courses and to use a computer before and after school or for game playing. Girls made up 86% of enrollees in word processing classes and only 37% in programming classes in high school (Linn, 1985).

As with research on computers for the general population, children of different genders use computers in different ways. Harris (1999) found a significant difference in use between the genders: boys spent the majority of their time playing games, whereas girls spent most of their time on word processing. Girls were more likely to use the computer as a tool to accomplish a task, whereas boys were more likely to see computers more as a playful, recreational tool (Fiore, 1999). This same gap is found in the computer software market, where an estimated 80% of entertainment and learning software is purchased by and for boys (Dorman, 1998).

By the 1990s, new research results began to suggest that there was a growing trend towards increased access to and use of technology, and schools were one of the driving forces in the reduction of this gap (Bergin, Ford, & Hess, 1993). In 1993, access and use of computer in schools was found to be increasing faster than the use of computers outside of school. By 1997, 70% of children used computers in some way,

over twice the result that was found in 1984. In 1984, 30% of children between the ages of 3-17 had used a computer in some location, and by 1997 this has risen to 75% (United States Census Bureau, 1994).

While access is important, it is not always enough. Martinez and Mead (1988) found that children from higher socioeconomic groups achieved a larger educational advantage from using computers than children from lower socioeconomic status, and that boys' performance advantage was larger than girls'.

Computers and Education

Children begin school with similar interest and aptitudes for computers, but this changes as they develop (Bergin et al., 1993). As children move through the elementary grades, into middle and high school, girls tend to show less interest in computers than boys. The middle school years are considered an important time to make a difference in students' computer attitudes and use (Butler, 2000; Mark & Hanson, 1992). Researchers found that this is the time when boys begin to use computers more than girls (Sheingold, 1981). By eighth grade, sex differences in attitudes are firmly established, and even though girls say that they have the same ability to use computers as boys, they do not feel competent and self-confident on the computer (Collis, 1985).

The way children are socialized impacts their opinions of computers. During the middle school years and puberty, kids get the message that computing is for boys (DeBare, 1996), and that overall, boys have a much more positive attitude towards computers than girls (Sutton, 1991). In addition, gender research shows that girls and boys are socialized differently and that they have distinct learning and interactivity

preferences (Solsken, 1993). Boys prefer individualistic, often competitive learning environments, whereas girls prefer cooperative learning environments and community-based activities (Corson, 1992). In addition, parents were found more likely to reinforce boys' computer use than girls' (Hanson, 1997).

Other researchers believe that the way students are taught about computers and technology impacts their perceptions and opinions. Proctor and Burnett (1996) found that the way computers are taught has a greater effect on student attitudes towards computing than gender differences. This conclusion supports the notion that trying to influence and to increase girls' computer use during the school years may have long-term effects on their opinions and use of computers. They found that students' attitudes were influenced by quality of access to computers and the quality of experience when using computers. Increased access to computers had no impact on students' perceptions or on their confidence when using computers. In one study, Okebukola (1993) found that more computer use resulted in a decline in students' interest in computers.

Just increasing access to computers is not enough, the quality of teaching is also important in changing students' perceptions and opinions of computers. Proctor and Burnett (1996) found that placing computers in schools does little if they are not supported by a curriculum that promotes positive use of computers. Linn (1985) studied the computer curriculum in middle and high schools and found the curriculum to be inadequate. The content of the curriculum was found to be cognitively undemanding, and some serious constraints were found in regards to access to machines, curriculum,

and teacher experience. These constraints were found to account for the limited gains from students taking programming courses at this level.

Other research found gender differences in learning styles impact students' attitudes. Girls learn to use computers differently from boys, and generally take longer to learn things on computers than boys. When they were given more time, they outperformed boys (Hoyles, 1988). Others suggested that grouping students by sex helps to overcome any disadvantages girls might have when working on computers (Linn, 1985). When girls work on computers, they prefer collaborative work; they support and encourage one another in their work, and give equal computer access to all the members of the group (Nicholson et al., 1998; Sanders 1985). In contrast, boys were more competitive and were more likely to create competition among groups by comparing and pointing out differences. To help accommodate these differences, some researchers suggest that schools should provide optional supervised computer lab time to ensure equal access to girls and boys (Fredman, 1992). Others suggest that schools should provide a variety of activities on the computer, such as general writing or reading, as this is believed to make a big difference in girls' attitudes toward and use of computers (Eastman & Krendl, 1987).

Problems with Earlier Studies

The majority of studies on the use of computers by adults and children were completed before the Internet emerged. The Internet has radically changed the meaning and uses of a computer, which might change the results of these studies if they were completed again today.

Since the 1980s, computers have undergone a dramatic transformation. Computers are no longer isolated machines and users are no longer restricted to the information stored locally on their computer hard drives. Instead, they have become a part of a worldwide network of computers known as the Internet. The computer has become a communications tool that allows people to engage in instantaneous and two-way communication.

The Diffusion and Reinvention of the Internet

The Internet is a worldwide network of computers that offers users a fundamentally new way to communicate and use technology. It was originally created to protect the U.S. Military's communications networks in time of war. The precursor to the Internet, the Advanced Research Projects Agency Network (ARPANET) began in the 1960s (Dern, 1994) with grants from the Department of Defense. Officially, the Internet was designed to connect the 1,000 scientists, researchers, and educators who were collaborating on weapons-related research. The goal was to develop a communications network with no central point that could hold up in the face of a nuclear attack. Like the interstate highway system in the United States, the Internet was created and funded by the military and ended up serving a greater civilian purpose.

The Internet was not just used to send military information but also introduced a new communications network to society. As more and more people adopted the Internet, it was reinvented and evolved into a worldwide mass communications network. From very early on the Internet was not used solely for military purposes. Hafner and Lyon

(1996), in the book *When Wizards Stay Up Late*, noted that one of the first managers of the ARPANET project, Joseph Carl Licklider (Lick), was a psychologist, not a soldier:

> Lick's belief in the potential of computers to transform society became something of an obsession.... The idea on which Lick's worldview pivoted was that technological progress would save humanity. Lick's thoughts about the role computers could play hit a crescendo in 1960 with the publication of his seminal paper "Man-Computer Symbiosis." Lick suggested that man and machine would perform far more competently than either could alone. (p. 34)

Rheingold (1993) went further to suggest:

> People who believed in, wanted, and invented ways of using computers to amplify human thinking and communication created the essential elements of the Net. [Rheingold claimed that] those who built the Internet aimed to provide the resource to the widest possible audience, at the lowest possible cost. (p. 1)

Not only is the diffusion of innovations theory useful for examining the sequence of adoption of new ideas and technology, it also helps explain how and why ideas or technology changes as they are adopted. The diffusion of innovations theory helps explain why the Internet changed from an elite research network to a mass communications network. Rogers (1995) found that not all innovations are used in the same way, but that all new ideas and innovations change and evolve during the diffusion process.

This process is known as *reinvention*, which occurs when an innovation is changed and modified by a user in the process of adoption and implementation. An innovation that is considered to be a tool or a concept that has many applications is more likely to be reinvented:

> This concept presented a strong argument for measuring adoption during the implementation stage rather than just as an intention to act. Adoption is the decision to make full use of an innovation, which is invented by someone else.

> Reinvention describes the degree to which an innovation is changed or modified by the user in the process of its adoption and implementation. As a result of reinvention, an existing innovation may be more appropriate in matching an adopter's pre-existing problems and more responsive to new problems that arise during the innovation-decision process. (Rogers, 1995, p. 174)

Two technological innovations introduced in the 1990s accelerated the Internet's move from the research arena to the mass market. The first was the introduction of hypertext to provide a simple navigation system for the Internet, also known as the World Wide Web. The second was the introduction of the Mosaic browser, the forerunner to the Netscape browser (Hafner & Lyon, 1996). The new browser introduced the first easy to use interface on the Internet and enabled the delivery of pictures and dynamic text to the end user, "making the Internet as easy as pointing a mouse and clicking on the pictures" (p. 258).

Mass Communications

What makes an innovation a mass communications medium? Wright (1986) defined mass communications as "communication that targets a relatively large, heterogeneous, and anonymous audience" (p. 4). This definition assumes that there is no interaction between the communicator and the audience. On-line, however, interaction is the rule, and the Internet permits content providers to know and interact with their audience.

The field of mass communications has embraced the Internet and the new research opportunities it offers. Strangelove (1994) wrote that the Internet has created a new form of human communication, which he defined as "mass participation in bi-

directional uncensored mass communication" (p. 3). Strangelove suggested that the Internet has changed the idea of mass communications forever:

> On the Internet we find massive numbers of people providing information to massive numbers of people. The introduction of the Gutenberg press made mass communication possible only for the very few that could own a printing press, whereas the Internet has turned every owner of a computer, a modem, and a telephone line into a publisher, a radio station and soon a television station. (p. 4)

Morgan (1997) found that the convergence of computers and other communication networks made it difficult to distinguish between interpersonal and mass communications. Using these technologies, personal communication can be targeted to individuals and, at the same time, to the masses. For example when one is participating in chat rooms, individuals can be talking one-on-one to individuals or simultaneously to a large audience, using the same means of communication.

Consensus on the significance of the Internet does not prevail in the mass communications field. Stephens (1998) noted that it is too early to declare that a mass communications revolution had occurred. He suggested that it takes time for new mass communications media to evolve and that the Internet "might only be a step in the development of moving images and that we might be in the midst of a video revolution rather than an Internet revolution" (p. 12). It is true that, since the introduction of television and now the Internet, images are more important in the presentation of information than ever before.

The Internet Impacts Earlier Findings

Most researchers agree the Internet has become new mass media or is at least the first step in that direction. Since the majority of studies that looked at the gender gap in

computer adoption were conducted in the 1980s before the introduction of the Internet to the mass market, an opportunity exists for researchers to revisit these earlier studies to see if the Internet is changing women's perceptions, opinions, and use of computers and technology.

The diffusion of innovation theory can also be used to track the progress of the Internet in society. Like computers, the Internet was not adopted simultaneously by all segments of the population. As Rogers (1995) suggested, during the first few years of an innovation, only a small number of people are adopters. In the case of the Internet, the innovators were academics involved in the research and development of computer networks. However, as the price of Internet access has fallen and as technology has improved, more people have moved on-line.

In 1999 the Internet appears to have reached a *critical mass* in Western societies. As Rogers (1995) noted:

> The critical mass occurs at the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining. An interactive innovation [like the Internet] is of little use to an adopting individual unless other individuals with whom the adopter wishes to communicate also adopt. (p. 313)

As with computers, researchers found that the early adopters of the Internet were predominately male. In 1995 Plotkinoff (1995) found that Internet users were predominately "elite male users aged between 30-34 years" (p. 10E). Span (1994) found that the male population for on-line services was "as high as 90% for CompuServe, 85% for America On-line (AOL), and 70% for Prodigy" (p. 2).

Today, media and market researchers suggest that the Internet is beginning to reflect the demographics of the population as a whole, and women represent one of the Internet's fastest growing audiences. A study by Media Metrix and Jupiter Communications (2000) found: "Women, young and old, joined the ranks [of Internet users] to claim 50% of all unique visitors to the Web in May 2000, just edging out male counterparts with a 49% share of the same population" (p. 3). They also found that teen girls, aged 12-17 years, represented the fastest growing age segment with a 126% increase in unique visitors for this age group from 1999 to 2000 (p. 4).

The adoption gap between the genders appears to be closing faster for the Internet than it did for computers. As with computers, early users of the Internet were predominantly male. Then as the adoption became more widespread, women began to use the technology. There are several factors that may explain this. As discussed earlier, researchers found that women were not interested in using computers for a variety of reasons. Some women felt that there was a lack of content that targeted their interests and needs (Huff & Cooper, 1987; Hess & Miura, 1985) and others said they preferred interpersonal communication rather than working in isolation on a computer (Hanor, 1998). But with the Internet, many of these factors no longer exist. The Internet allows women to use computers to send e-mail and instant messages, which allows them to develop interpersonal relationships on-line. When compared to software programs available for PCs, the Internet offers a greater variety of information to users, making it more likely that women's interests will be met on-line.

Research found that women use computers and the Internet differently from men. Brunner and Bennett (1998) noted that "the Internet, particularly the World Wide Web, is as likely to appeal to women as to men. The ability to communicate with others and share ideas, stories, news, and advice corresponds to the feminine fantasies found in our research" (p. 2). Hanor (1998) found that, in comparison to men, women prefer to participate in interpersonal sharing and use computers for communication. Women also use the Internet to help them in their day-to-day responsibilities rather than for recreational purposes. Women are frequently charged with managing family budgets and households (Boutilier, 1993) and the Internet offers them a more flexible way to manage their time and resources. According to "Ms. Net" (1998), women use the Internet as a time-saving tool to help manage their career, family, and household duties, and that "71% of women use the Net for shopping on-line and 54% have bought at least one item on-line " (p. 1).

Even in young children, research has found that girls use the Internet differently from boys. Boys between the ages of 12-17 years spend more time on-line playing games, while girls in the same age group spend more time on the Internet for schoolwork (The UCLA Internet Report, 2000). Boys were also found to use the Internet more to look up news, sports, and weather information than girls, whereas girls were more likely to use the Internet to send and receive e-mail (United States Census Bureau, 1997).

Computer use may also have helped prepare women for the Internet, since using computers enabled women to get familiar with the design and commands of the computer interface, and made the transition to the Internet a less difficult one. As a consequence,

the Internet did not earn the same reputation of being hard-to-use as computers, and this has made it more attractive to inexperienced users. This is not to suggest that women can't use complicated machines, but research has shown that women are less likely to have positive opinions and to persevere with machines if they face a problem (Brunner & Bennett, 1998). The ease of use offered by the Internet may avoid some of these problems.

New Trends First Show Up in Early Adopter Populations

To find out if the Internet is helping to close the gender gap in the use and perception of personal computers, it is logical to start with the early adopters because this is where the changes should show up first. Research suggests that differences in economic status affect the adoption of new technologies (Rogers, Daley, & Wu, 1982; Tichenor, Donohue, & Olien, 1970). Using Rogers' (1995) terminology, it could be said that higher economic groups would be represented more often in the innovator and early adopter groups than less affluent people. It is also expected that school age children in affluent areas would be in the early adopter group for computer and Internet technologies.

In an early study on the diffusion of home computers, researchers Rogers, Daley, and Wu (1982) found:

> There was a strong positive association between personal income and usage of the home computer for work-related word processing. While 30% of respondents with incomes above $40,000 reported relative high usage for work-related word processing, only 8% of those with lower incomes reported the same. Income is positively associated with usage for database access, business management, and learning aids for children. (p. 72)

The possible link between income and innovation is further explained in Tichenor, Donohue, and Olien's (1970) knowledge gap theory:

> As the infusion of mass media information in a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease. (p. 159-160)

This theory has been used to study the gaps in information acquired and information retained by people through the learning process and helps researchers better predict what segments of the population are more likely than others to take up new inventions.

From the studies on computer usage of middle school students, this age group can be assumed to be an early adopter group. Early studies are beginning to suggest that the difference in the amount of time that girls and boys spend using computers might be declining. Dorman (1998) found that boys and girls in middle schools are beginning to spend the same amount of time using computers at home. However, for children in high school, differences were still found. In 1995, girls were reported to have spent an average of 5.7 hours per week using the computer whereas boys spent an average of 7.7 hours ("Computer Use," 1995). At the same time, adults still experienced the gender gap in computer use.

Overview of Relevant Theory

This study aims to update earlier computer gender gap research and to find out how the Internet is impacting women's opinions, perceptions, and use of personal computers. It takes questions suggested by the literature, and examines them in a

population that is expected to be a group where trends in Internet use would first show up. School-aged children were selected for this study because education is considered to play an important part in the rate of adoption of a new technology. In much the same way that schools gave children access to computers, they are considered also important in giving students' access to the Internet. What kids learn in school has a large impact on their attitudes toward technology, so if you look at children now, it is more likely that they will presage new trends for the future.

An analysis of the literature suggested that women were less interested in computers and technology for a variety of reasons. Some studies found that personal computers were not considered as appropriate for women as for men (Pearl et al., 1990) and that women form their ideas about what is right and wrong for their gender at an early age (Kohlberg, 1966). A lack of content targeting women was another reason women were not found to use computers as much as men (Huff & Cooper, 1987). These conditions made it less likely that women would get the computer experience they needed for success in a high-tech career (Hess & Miura, 1985). Computer culture was also found to deter women from becoming interested in technology (Keisler et al., 1985). It appears, however, that the Internet may have helped overcome some of these hurdles.

The Internet has changed the personal computer into a mass communications network that gives users access to a worldwide web of information (Strangelove, 1994). As the number of women on-line fast approaches the number of men on-line (Corcoran, 1999), it appears as though the Internet has gained both gender and cultural acceptance at a faster rate than personal computers. Researchers have put forward some reasons that

women have been getting on-line. Some suggest that the information available on the Internet is more relevant to women's interests and needs (Brunner & Bennett, 1998). The Internet also allows users to strengthen interpersonal relationships through two-way communication, an activity that was found to be important to women (Hanor, 1998). Women also use the Internet to help manage their time and their domestic responsibilities (Boutilier, 1993). Girls were also found to use the Internet differently than boys (The UCLA Internet Report, 2000).

It is clear that the Internet has changed the role computers play in society; these changes provide an opportunity for researchers to revisit the earlier gender gap studies to see how the Internet has impacted this gap. The goal of this study is to provide some early data that shows that the gender gap in computer adoption is beginning to disappear because of the Internet.

Rogers' (1995) diffusion of innovations theory and the Tichenor et al. (1970) knowledge gap theory assume that people in higher socioeconomic segments with more disposable income and higher education levels are more likely to adopt an innovation. As a consequence, the high socioeconomic population of Palo Alto was selected because this population would most likely represent what Rogers called the early adopters. In addition, children were selected for this study because it is expected that new trends will come out of this population because of the increased access offered through schools and the influence of education on their attitudes.

Research Questions

The overall question of this study is: How has the Internet impacted the computer gender gap? This research aims to answer the following questions:

1. What are girls' perceptions and opinions of computers and the Internet, and are they different from boys'?
2. Do girls have as much access as boys to computers and the Internet?
3. Do girls spend as much time as boys using computers and the Internet?
4. What do girls use computers and the Internet for, and is it different from boys?

CHAPTER THREE

METHODS

This study examines girls' and boys' access, use, opinions, and perceptions of computers and the Internet. As Rogers (1995) suggested, people are more open to adopting technologies that they have a perceived need for and that fit in with their existing values, experience and needs (p. 224). Previous research looked at gender differences in the use of computers and found that women were less likely to have positive perceptions and opinions of technology and computers. However, the majority of this research was completed before the Internet became mainstream and needs to be updated.

Qualitative and quantitative research methods were used to study girls' and boys' use of these technologies. A combination of participant observation, survey, and focus group research was used to gather the data. The practice of combining research methods to gather and meld a range of evidence is known as triangulation, and the goal of this practice is to help clarify earlier results and to better develop a concept or a proposition (Lindlof, 1995, p. 239).

Research Site

To study the use of computers and the Internet, it is helpful to have a sample population that has access to and is likely to use these technologies. The Palo Alto Unified School District, located in a high socioeconomic area, was selected because a large majority of students use computers at home and at school. According to the *Palo Alto Daily*, mean household income in the school district was expected to reach $98,000

by the year 2000 ("Palo Alto by Numbers," 2000). The characteristics of this area make it possible for the researcher to study computer and Internet usage, opinions, and perceptions.

Jane Lathrop Stanford Middle School was selected as the school for this study. According to Jane Lathrop Stanford Middle School's (1998) *Report to the Community*, there are 1,120 students in the sixth, seventh, and eighth grades. The students come from the Palo Alto, Stanford, and Los Altos Hills areas and are supported by 140 administrative and teaching staff. The student body is 24% Asian, 6% Hispanic, 3% African-American, and 67% white. About 10% of the students are considered to be limited English speaking students.

The researcher contacted and received approval from Palo Alto School District for this study (see Appendix A). A copy of the parental consent form, a list of preliminary questions and an outline of the research proposal were submitted to the district as a part of this process. In addition, the researcher received approval from the principal at Jane Lathrop Stanford Middle School, Joy Addison, who reviewed and approved all the documentation given to the district. She gave permission provided that the study did not interfere with student learning and was conducted outside of class time. The principal suggested that the parental consent form and some basic questions about computer usage be distributed as a part of an official school survey on student access to computers. The researcher received approval from San Jose State University's Human Subjects panel for this study.

A purposive sample was used for this study. According to Hsia (1988), researchers use a purposive sample because the chosen sample is expected to provide typical results to suit the purposes of the researcher (p. 132). One of the major shortcomings of a purposive sample is that the results cannot be generalized to the population at large. However, the results can be used to develop hypotheses that can be tested on a random sample in a future study.

Data Collection

Three complementary research methods were used to study this sample; participant observation, focus groups, and survey research.

Participant observation. The first method was participant observation, which was used to refine the research questions and provides preliminary data for the study. This method was used to analyze students' use, behavior, and perceptions of computers and the Internet. The researcher observed students during a two-week period in the computer laboratory at Jane Lathrop Stanford Middle School. A total of 80 hours of observation were completed. Observations were made and categorized to see if any consistent patterns were found. The results were used to modify or support the research questions in this study.

Focus groups. The second research method used in this study was focus groups. Focus groups are generally used to help researchers understand audience and consumer behavior (Wimmer & Dominick, 1991). In this study, focus groups were used to help the researcher formulate the survey questions. Two, hour-long, focus group sessions were held, one for boys and one for girls, with a total of 18 students in each group. During the

sessions, the researcher took a more in-depth look at how individual students use computers and the Internet, and compared usage patterns, opinions, and perceptions between the genders. Participants were recruited based on their responses to the questions on the parental consent form. A purposive sample targeting students with computers and access to the Internet was selected for the focus group discussions. This sample enabled the researcher to compare and contrast perceptions and opinions of students with similar computer and Internet usage patterns. Results from the focus group sessions confirmed and extended findings from the earlier stages in the study.

Survey research. The third research method used in this study was survey research. The researcher pre-tested the questionnaire for ambiguities and problems on 10 students before distributing it to the entire sample. Once the necessary changes were made, the survey (see Appendix B) was distributed to all students who returned their parental consent form and was completed during homeroom meetings. The survey included 24 questions about student's computer and Internet use, opinions, and perceptions. A combination of fixed-choice, rating, and ratio scale questions were used, including two rating scales where students were asked to rate their skills on scale from one (poor) to 100 (excellent).

Questionnaire Construction

The questionnaire was constructed to address the research questions. The independent variable in all questions was gender. The dependent measures were access and use.

The first research question, what are girls' perceptions and opinions of computers and the Internet, and are they different from boys', was investigated in several questions in the survey. In question 16, girls and boys were asked to rank their computer abilities on a scale from 1 (no computer skills) to 100 (excellent computer skills).

In addition, girls and boys were asked a series of questions and asked to rank their responses on a five-point Likert scale, from strongly disagree (1) to strongly agree (5). Some of the statements were: Computers are very important to my future career; Learning about computers and the Internet is not a priority for me; It is difficult to find things on the Internet; Surfing is a waste of time; Nothing interests me on the Internet.

The second research question, do girls have as much access as boys to computers and the Internet, was analyzed in a number of questions in the questionnaire. Girls and boys were asked if they had access to computers: In this question, the dependent variable was access. They were also asked how many people they shared their computer with, and the dependent variable was the number of people they reported.

In an effort to study how much freedom students had when accessing a computer, they were asked if their parents check where they go on-line and if they are allowed to use the Internet when their parents are not around. Girls and boys were also asked where their computers were located. Based on the location, some assumptions were made on the amount of monitoring that was carried out. If students used the computer in a family room, for example, it was considered more likely that the children were being monitored than if they were using it in their bedrooms.

The third research question was, do girls spend as much time as boys using computers and the Internet? The dependent variable is the amount of time that girls and boys reported using computers and the Internet in an average week.

The fourth research question was, what do girls use computers and the Internet for, and do they use it differently from boys? To answer this question, girls and boys were asked to indicate what types of information they look for when using the Internet, such as sports, news, and new products, especially computer and electronic products. They were also asked about the activities they engage in when they use the computer for school and recreational purposes. For this question, students could choose from a number of different options including sending e-mail, typing papers, using graphics programs, and surfing the Internet.

Data Analysis

The survey data were collected and entered into the statistical software package, SPSS, and analyzed. The researcher ran a series of statistical tests to determine if any significant results were found in the data collected. A combination of *t*-tests, one-way ANOVAs, correlations, and chi-square tests were run to see if the data indicated any significant differences between the ways that boys and girls think about and use computers and the Internet.

CHAPTER FOUR

RESULTS

This section presents the findings and an interpretation of the qualitative and quantitative analysis. It answers the research questions for this study: What are girls' perceptions and opinions of computers and the Internet and are they different from boys'? Do girls have as much access as boys to computers and the Internet? Do girls spend as much time as boys using computers and the Internet? What do girls use computers and the Internet for, and is it different from boys? The results of this study are organized into a general overview section and then are broken down by specific research questions.

General Overview

More girls (55%) responded to the survey than boys (45%). Students ranged in age from 11 to 14 years old, and the average age was 11 years. Of those surveyed, 19% were born outside the United States and 29% listed English as their second language. Sixty-seven percent of the respondents had previously taken computer classes at Jane Lathrop Stanford Middle School. As expected, student access to computers was high, with more than half of the students owning their own personal computer at home. Students who shared a computer, shared it with an average of three people. Of 160 possible participants, 102 completed the questionnaire, resulting in a response rate of 62%.

Characteristics of the sample. The student population at Jane Lathrop Stanford Middle School was similar to the student body at Palo Alto's other middle school, Jordan Middle School (California State Education Department, 1999). Both schools have

around 1,100 students, a pupil teacher ratio of 1:17, and an average class size of 28 students. Regarding access to technology, Jane Lathrop Stanford reported a greater number of computers (274 to Jordan's 198) and a lower ratio of students to computers (4.3 students per computer compared to Jordan's 5.5 students). Both schools reported a similar number of classrooms with Internet and Wide Area Network (WAN) access: Jordan reported 58 to Jane Lathrop Stanford's 59. Jane Lathrop Stanford also reported more non-English speaking students: seven percent of the student body is English learners, while Jordan reported no English learners. English learners are students for whom English is a second language and who have been determined to lack the English language skills necessary to succeed in the school's regular instructional programs.

When compared to averages across the state of California, the Palo Alto School District varies greatly from the state averages in a number of key areas (California State Education Department, 1999). The district has fewer non-English speaking students; the district average is 5% as compared to the state average of 24%. The pupil-to-teacher ratio in the Palo Alto School District (17:1) is less than the state average (21:1). Palo Alto also has fewer students who qualify for the school lunch assistance program than the state average. On average, 47% of students qualify for assistance in the state as a whole whereas Palo Alto reports 7%, which confirms the socioeconomic status of the area. Finally, the student computer ratio is above the state average: Palo Alto reports a ratio of 5:1, whereas the state reports a ratio of 8:1.

Based on this sample, a number of interesting results were found. Below is a summary of the findings organized by research question.

What Are Girls' Perceptions and Opinions of Computers and the Internet and Are They Different from Boys'?

Overall, girls and boys were found to have positive opinions and perceptions of computers and the Internet. However, some gender differences were apparent at different stages of the study. During the observation stage, girls appeared more intimidated by computers than boys. In the focus groups, boys were more likely to describe computers and the Internet as sources of entertainment, whereas girls described them more as tools that helped them get things done, to find information, and to do homework.

Observation. During the observation stage, several gender differences were noted. Girls appeared to be more intimidated by computers than boys. In general, when a girl faced a problem using a computer, she would not try to solve the problem, and generally looked to others for assistance. Boys, however, were less concerned when things went wrong and generally tried to overcome the problem themselves before asking for assistance from others.

In computer class, girls appeared less assertive when asking for help than their male counterparts. The computer teacher at Jane Lathrop Stanford Middle School devised a system of getting students to ask for help. To request assistance, students had to put a red cup on the top of their computer monitor and wait for the teacher to arrive. However, often the boys would yell out and raise their arms to get the teacher's attention and, as a consequence, they were often attended to faster than the girls. After one computer class, some girls reported that they believed that boys were favored more in computer class than girls.

Focus groups. During the focus group sessions, girls and boys expressed equally positive opinions about the Internet. When asked how they would describe the Internet, girls said that it was like a magazine where they could find and read information on subjects that interested them. In contrast, the boys thought of the Internet in broader terms. One boy said "the Internet is a source of entertainment, like a mall, where you can access books, music, and entertainment all in one place."

Boys were also more likely than girls to report that the Internet was a social place, where they could meet friends, play games, and chat with one another. One boy said that "the Internet was more private than using the telephone to talk with friends, as my little brother can not listen in." Another said that, "me, and four or five other friends meet on-line and chat after school. It is better than a phone as I can speak to all of them at once." Few girls reported using chat rooms, and they were more likely to use the Internet to research their hobbies and interests.

During the focus groups, girls and boys complained that the Internet was difficult to navigate and that there was a lot of useless information available on it. Girls were also more likely to report that the Internet was not always the best place to go for information because it takes so long to find the information they need. They sometimes felt that the Internet was a waste of time.

Girls' perceptions of computers may also be impacted by the opinions of their peers. When boys were asked why girls were less interested in computers, they reported that girls were generally less likely to like computers. One boy said it was because "girls don't have as much experience with them, and that they don't like technology as much as

boys." Another said that "girls are more scared of trying out new things and taking risks than boys." When they were asked if they felt that it was as important that girls know about computers as boys, one boy replied: "Girls are more likely to become homemakers, and boys are more likely to be more involved with computers outside of the house, so it is not as important for girls to know how to use computers."

Survey. In the survey, students' opinions and perceptions were further investigated. Boys and girls were asked to rate their computer skills on a scale of 0 (no computer skills) to 100 (excellent computer skills). Table 1 shows that no significant difference was found between the way boys and girls ranked their abilities.

When it came to their opinions toward computers and the Internet, boys reported more favorable perceptions in only three instances. When boys and girls were asked if they knew more about computers than their parents, significantly more boys (64%) than girls (36%) reported greater knowledge than their parents ($\chi^2(1, N = 100) = 7, p < .01$). As shown in Table 2, students were asked to rank six statements on a five-point Likert scale. There were statistically significant differences between girls and boys on two of the attitudinal measures. Boys were more likely than girls to agree with the statement "boys are naturally more skilled at using computers than girls." Girls and boys were asked about their attitudes towards women and their role in the technology industry. When asked whether "it is more important that boys know about computers than girls, as boys were more likely to work in the technology industry," significantly more boys than girls agreed with this statement. Table 2 also shows that more boys than girls agreed that

computers are easy to use, although the difference between the genders was not significant.

Students were also asked several questions to determine how closely they tie computers and the Internet to their future career goals. Boys and girls both agreed that computers were important to their future professions. Also, when students were asked to indicate their interest in technology in general, and there were no differences based on gender. Although, when compared to girls, boys were more likely to agree that they were on the cutting edge of technology and technological advances, and that it was important to keep up with the latest technologies, these differences were not significant.

Table 1

Student rating their computer abilities

Question	*N*	*M*	*SD*	*SE*	*t*
How do you rank your computer skills on a scale from 0 to 100?					.26
Girls	50	65.76	18.61	3.01	
Boys	43	65.65	21.25	2.84	

Table 2

How students ranked statements about computers and the Internet

Statement	*N*	*M*	*SD*	*SE*	*t*
It is more important that boys know about computers than girls, as boys are more likely to work in the technology industry.					.00*
Girls	52	1.23	.51	7.06	
Boys	48	1.98	1.02	.15	
Boys are naturally more skilled at using computers than girls.					.00*
Girls	52	1.50	.78	.11	
Boys	49	2.10	1.14	.16	
Using computers is very easy for me.					.14
Girls	52	3.58	.94	.13	
Boys	49	4.02	.85	.12	
It is difficult to find things on the Internet.					.48
Girls	51	2.90	.7	.13	
Boys	48	2.49	.91	9.84	
I always find information that interests me on the Internet.					.51
Girls	53	3.40	1.08	.16	
Boys	48	3.54	1.13	.15	
I usually blame myself when my computer crashes.					.60
Girls	53	2.23	.89	.12	
Boys	48	1.90	.86	.12	

Note. Means on the Likert scale ranged from 1 to 5, with 1 representing strong disagreement with the statement, 3 representing neither disagree or agree, and 5 representing strong agreement.

*$p < .05$

Do Girls Have as Much Access as Boys to Computers and the Internet?

There were no significant differences found in physical access to computers and the Internet between boys and girls in this study. Access was measured in a variety of ways. In the survey students were asked if they had a computer of their own at home or if they had to share it with others. Although fewer girls than boys reported having a computer of their own at home, the difference was not found to be significant, suggesting that boys and girls have equal access to computers at home.

Students who share a computer were asked how many people use the same computer. On average, girls shared the computer with two people, whereas boys shared it with three people. The difference between the number of people that girls shared with as compared to boys was not statistically significant.

Student access to the computer is not restricted to the computer itself, but can also be impacted by the amount of time a student has to devote to an activity. During the focus groups, many of the girls said that they were too busy to use computers in their spare time. In contrast, no boys reported that a lack of time was a problem when it came to finding time to spend on the computer. When girls were asked what caused this difference in the perceived availability of time, girls said that boys didn't care as much about their homework as girls and that they didn't have to do as much around the house as they did.

The issue of available time and computer use was addressed in the survey (see Table 3). More boys reported that they had time to explore the Internet than girls. The

difference between the numbers of boys versus girls who said that they had time to explore the Internet showed a slight tendency toward significance.

Children were asked how much their parents' monitor their time on-line. As Table 3 shows, no significant differences were found between the way girls and boys were supervised. Girls and boys were asked where their computer was located (see Table 4). More girls (39%) reported that they had a computer in their bedroom, but boys (51%) said they used a computer in the family room, where it is more likely that parents can see what they are doing. To further look into parental involvement in children's computer use, students were asked to rank the following statements: I go wherever I want on-line, I only go to the web sites that my parents approve of, and my parents don't care what web sites I visit. A series of independent *t*-tests were performed, but, as Table 3 shows, no significant differences were found between the way boys versus girls ranked these statements.

Girls and boys were asked if they have to ask permission to use the Internet, 28% of girls and 36% of boys reported that they had to ask permission before using the Internet, and 19% of boys and 21% of girls said that they were not allowed to surf the Internet while their parents were not around. Finally, they were asked if their parents check which sites they visit on the Internet, 70% of boys and girls reported that their parents did check where they went. No significant differences were found in the way boys versus girls answered these questions.

Table 3

How students ranked statements about parental monitoring of Internet use

Statement	*N*	*M*	*SD*	*SE*	*t*
I have plenty of spare time to explore the Internet.					.08
Girls	51	2.61	1.04	.15	
Boys	48	3.00	1.17	.17	
My parents don't care what web sites I visit on the Internet.					.15
Girls	53	2.55	1.01	.14	
Boys	49	2.27	.93	.13	
I go wherever I want on-line.					.47
Girls	53	2.61	1.10	.16	
Boys	49	2.77	1.14	.16	
I only go to the web sites that my parents approve of.					.99
Girls	53	3.24	1.07	.15	
Boys	49	3.25	1.16	.17	

Note. Means on the Likert scale ranged from 1 to 5, with 1 representing strong disagreement with the statement, 3 representing neither disagree or agree, and 5 representing strong agreement.

Table 4

Where girls and boys use the computer at home

Girls	*%*	*Boys*	*%*
My bedroom	39%	Family room	51%
Family room	28	My bedroom	22
Parent's home office	16	Parent's home office	10
Another bedroom	9	Other	9
Other	8	Another bedroom	8

Note. Students were asked for the location of their computer. They could choose from the following rooms: family room, my bedroom, another bedroom, kitchen, parents' home office, and other.

Do Girls and Boys Spend as Much Time Using Computers and the Internet?

Girls and boys reported spending equivalent amounts of time using computers and the Internet. The study did not, however, ask students how many years they had been using computers, which may have highlighted greater variation between the genders than what was found.

Observation. During the observation stage, most boys demonstrated a greater comfort, interest, and familiarity with computers than girls. Boys appeared more likely than girls to get engaged in more technically difficult activities, such as downloading games and programs onto the school's computers and playing them during class time. During one class, some boys managed to network the computers and compete in real time

against each other across the network. In contrast, girls rarely used the web in their free class time but instead chose to talk in groups rather than to wander off into cyberspace.

Boys appeared to have more overall experience using the Internet than girls. Boys appeared to know exactly where to go on-line and had no trouble finding what they wanted, whereas girls were more likely to ask the teacher where to go. Boys were also more likely than girls to surf the web when the teacher was not looking. Boys use the Internet to find information on new games and strategies, about the latest cars, and sports information. In contrast, girls rarely surfed the Internet during class time, and when they did they were more likely to use it like a magazine to find information on their favorite movie star or on the latest fashion trends. Even during the girls computer club, which was more likely to attract the enthusiasts, it was clear that very few of the girls knew where to go on the Internet. Only after the teacher provided them with a URL did they know where to go.

Focus groups. During the focus groups, a number of girls discussed how they use computers for recreational purposes. Several girls reported playing computer games, but only one girl said that she actively sought out action games. Another girl played a game called *Petz*, an animated game in which the player adopts cartoon dogs to become pets that they can play with on the computer. The majority, however, said that they use only the games that came with their computer. Others used their computers for drawing and painting pictures. One girl said "I never play on the computer; I just get on and do what I need to and then get off." In contrast, boys reported more diverse uses of computers.

Boys reported using the Internet for chatting, instant messaging, and playing on-line games in real time across the network.

Survey. The amount of time students spent using computers and the Internet was investigated in more detail in the survey, and no significant differences between the genders were found (see Table 5). When asked, in an average week how many hours do you spend using a computer at home and school, girls reported spending less time than boys. When asked how many hours they spend on homework a night, students reported spending an average of 2.6 hours, and, of that time, girls spent .9 hours using the Internet as compared to .6 hours for boys.

Table 5

Time that girls and boys spend using computers and the Internet

Question	*N*	*Hours*
In an average week, how many hours a week do you use a computer at school and at home?		
Girls	51	6.08
Boys	49	7.15
In an average week, of the time you spend on the computer, how many hours are on the Internet?		
Girls	51	3.12
Boys	49	4.62
Of the total time you spend doing homework, how much of it is spent using the Internet?		
Girls	50	.92
Boys	49	.62

What Do Girls Use Computers and the Internet for, and Is It Different from Boys?

In all stages of the study, it was clear that boys see the computer and the Internet as a source of entertainment whereas girls see it as a tool to help achieve a specific task or goal.

This was evident during the observation stage of this study when students were asked to create presentations. Girls were using computers to develop informational presentations. The girls worked on projects that showed visitors around their school or taught users how to speak a foreign language. In contrast, the boys developed presentations that mimicked computer games and developed battles and physical obstacles that players had to overcome before they could move ahead.

These observations were further supported by the survey data. Students were asked to give a percent next to a series of computer-related activities to rank how they spend their time on the computer. Table 6 summarizes the results. Although no significant differences were found between the ways that the different genders answered these questions, a number of interesting results were found. Typing, which most likely refers to homework, ranked highest for both genders, which is not surprising given that Jane Lathrop Stanford Middle School requires students to type school assignments. Some differences, although they were not found to be statistically significant, became more apparent for the activities ranked second and third. Girls used the computer to e-mail friends and family whereas boys were more likely to surf, supporting the earlier observation that boys tend to see computers more as a form of entertainment than girls.

One surprising survey result in this population was how high games ranked for female respondents. In this population a greater number of girls reported playing games for entertainment than the researcher expected; however, it was not ranked as highly for girls as for boys. Boys also ranked using the Internet to research new products slightly higher than girls.

Moreover, when asked to rank what they do on-line, boys and girls gave different responses. Although the differences were not found to be statistically significant, Table 7 shows that school-related activities ranked number one for girls whereas boys listed games. After the top two rankings, boys and girls reported using the Internet in different ways. Girls use the Internet to research their favorite celebrities and to obtain the latest beauty and fashion news, whereas boys search for new product information, sports news, and the latest technologies.

Table 6

What girls and boys do on the computer?

Rank	***Girls***	***Boys***
1.	Typing	Typing
2.	E-mail	Surfing
3.	Surfing	Games
4.	Games	E-mail
5.	Graphics	Graphics
6.	Chat rooms	Shopping
7.	Shopping	Chat rooms
8.	Other	Other

Note. Students were asked to rank their activities on the computer from what they do the most to what they do the least.

Table 7

What types of information do girls and boys look for on-line

Rank	*Girls*	*Boys*
1.	School assignments	Computer games
2.	Computer games	School assignments
3.	Celebrities	New products
4.	News	Latest technologies
5.	Beauty & fashion	Sports
6.	Other	Other
7.	New products	News
8.	Sports	Celebrities
9.	Latest technologies	Beauty & fashion

Note. Students were asked to put a check next to the activities they do on-line, and results for boys and girls were consolidated and prioritized by gender from the most frequently listed to the least.

Other Findings

This study found a number of other interesting results that go beyond the scope of the research questions.

Students were asked to rank where they go for help with their computer problems. For both girls and boys, dad ranked number one with self-learning ranked at number two as the most frequently used sources of help for computer problems. A significant

correlation was found for where boys and girls go as a third source of help. For girls, mom ranked as the third most important source of help with computer problems, and for boys mom ranked number 5. This relationship produced a significant negative correlation ($r = -.393^{**}$ $p < .01$).

Another interesting finding was that, despite the positive opinions and perceptions reported by girls in this population, girls were less likely to enroll in elective computer classes than boys. Fewer girls enrolled in web design ($\chi^2(1, N = 98) = 42, p < .05$), and computer programming ($\chi^2(1, N = 98) = 56, p < .05$), than their male counterparts.

The computer program at Jane Lathrop Stanford Middle School consists of both mandatory and elective classes. All students are introduced to computers through the mandatory keyboard class. In the next class level, students can take additional computer classes as an elective but this competes with other offerings, including home economics and electronics. The elective computer classes are more complex and give students the option to try computer programming and web design. Very few girls were enrolled in these more advanced classes. The number of boys who chose computers as an elective far outweighed the number of girls.

A number of interesting observations were made during the observation stage of this study. The researcher found that even the girls who chose computers as an elective did not appear to get as much as experience on computers as their male classmates. Many of the computer classes required students to work on group projects. The teachers were responsible for assigning the teams and, when there were enough girls, teachers

assigned boys and girls to mixed gender groups. In group situations, the leader was almost always a boy while the girls tended to observe and follow orders from the boys on technical issues. Girls were often charged with adding the aesthetic detail to a presentation, such as locating the right pictures or developing the text. They usually did not have responsibility for key components of the project. In all-girl groups, the girls tended to sit around one computer and work on the computer together. In all-boy groups, the boys were more likely to work on their computers separately and then come together as a group.

In addition, girls in the programming class chose the less complicated program, which required less scripting but offered the aesthetic benefit of color, whereas the boys tended to use the more complex program that was only black and white. Girls cited the lack of color as the reason they chose the easier program. The girls were more interested in adding a lot of detail to their presentations, whereas boys were more interested in the technical details and learning how to add scripts, action, and animation to their projects.

Gender differences were also observed in the way that students help one another. Students who finished their work were asked to assist others who needed help. When boys helped girls, the girls were more likely to give control of their keyboard over to the boys and let them complete the task. When girls helped girls or boys, they were more likely to provide direction and let the person stay in charge of his or her computer.

Overall, a number of interesting results were found in this study. Survey data showed that girls and boys were found to have positive opinions and perceptions of computers and the Internet, reported equal access, and spend the same amounts of time

on the computer and the Internet. However, based on the qualitative data, when the way students used these technologies was analyzed, differences were found: Boys generally used the computer for entertainment purposes and girls generally used it as a tool to help them complete a specific task. How these findings impact current research on gender and technology is discussed in the summary and conclusion section that follows.

CHAPTER FIVE

SUMMARY AND CONCLUSION

Relatively few differences were found in this study between girls' and boys' opinions, perceptions, and use of computers and the Internet. This study found that for this early adopter group of Palo Alto middle school students, the gender gap in computer use is almost non-existent. It updates earlier research on the computer gender gap and extends it to the Internet. Moreover, it examines girls' and boys' use of computers and the Internet, and compares opinions, perceptions, and use employing three research methods -- observation, focus group, and survey research.

Of the 24 questions included in the survey, only three of the tests resulted in significant gender differences, although in three of the comparisons there were slight numerical differences between boys and girls. The findings suggest that this may be the first generation of women who view and use computers in a way that is similar to their male counterparts. Since this is an early adopter population, the results may indicate that the gender gap in computer use is closing. One interesting qualitative finding from this study is that, although, girls and boys are spending equal amounts of time using computers and the Internet, there are differences in the way that girls and boys use and think about these technologies.

Three methods were used to strengthen the results of this study and to gather a combination of qualitative and quantitative data. The triangulation of methods helped to provide verification of the findings. Participant observation was used to study participants and to begin making some assumptions about their behavior and use of

computers and the Internet. Second, focus groups helped to research further the behaviors noted during the observation stage to see if what was observed was typical of the population as a whole. Finally, the results of the first two stages were consolidated into a questionnaire to determine whether there were gender differences.

As expected, student access to computers and the Internet was high; this finding parallels earlier research results that found that differences in economic status affect the adoption of new technologies (Rogers et al., 1982; Tichenor et al.; 1970). The population sample selected for this study was chosen because it represented an early adopter group as categorized by Rogers (1995). This was the case when student access to computers in the school district of Palo Alto was very high when compared to the state of California averages. The Palo Alto School District offered students more access to computers and the Internet: the state average was 8:1while Palo Alto boasted a 5:1 student-to-computer ratio.

Summary and Interpretation of Major Results

This study provides evidence that the earlier gender gap studies, completed before the Internet became mainstream, may no longer hold. No significant differences were found in terms of access or the amount of time spent using computers and the Internet, nor were significant differences found between girls' and boys' opinions and perceptions of computers and the Internet. However, differences were found in the way girls and boys use computers and the Internet. These findings, and how they relate to the current literature, are discussed in more detail below.

Access. Student access to computers was studied from several different perspectives. In terms of physical access, girls were found to have the same access to computers and the Internet as boys. This finding is important because it differs from earlier research that found that girls are less likely to have access to and use computers when compared to boys (Attewell & Battle, 1999; Swadener & Jarrett, 1986; Sutton, 1991; Wilder et al., 1985). This finding suggests that in this population, an early adopter group, access is no longer an issue and may not be a problem for the generation of girls now moving through the school system.

Access was not only studied in terms of physical access, but also in terms of how much freedom students had when using computers and the Internet, to see if girls had as much freedom using computers and the Internet as boys. No significant differences were found between the number of boys and girls who were monitored when using computers and the Internet. One interesting finding, although the difference was not statistically significant, was that more boys reported using the computer in the living room than did girls. This finding suggests that parents may be monitoring boys' time on-line more than girls'. In contrast, more girls reported using the Internet and computers in their bedroom.

Another issue that was found to impact student access to computers and the Internet was the amount of perceived free time that students felt they had. More girls than boys reported that they did not have enough spare time to surf the Internet and use computers. This finding suggests that girls prioritize computers differently than boys, or that other *more social* activities take priority.

Use. In this study, girls and boys spent the same amount of time using computers and the Internet. This is an important finding and adds support to Dorman's (1998) study that found that boys and girls in middle schools spent similar amounts of time using computers at home, it also differs from earlier research that found that girls use computers less than boys (Times Mirror, 1994; Culley, 1988). It may also mean that Sutton's (1991) findings that women were at a disadvantage because they were entering the classroom with less experience using computers than their male classmates may no longer be the case. More research needs to be done in this area to determine if the Internet, and its wide variety of uses and applications, is helping to reduce this gap.

Although girls and boys are spending the same amount of time using computers and the Internet, this study found that they are using them in different ways. Boys are more likely to see computers and the Internet as a source of entertainment, whereas girls are more likely to use the Internet and computers for school-related research and activities. This finding is significant and lends support to recent research that found that women are more likely to use computers and the Internet as useful, time-saving tools than as recreational toys (The UCLA Internet Report, 2000; Harris, 1999; Fiore, 1999; Hanor, 1998; Garrubbo, 1998).

Several other interesting findings were found in regard to the differences between the way boys and girls use computers and the Internet. One surprising result, related to student use of computers, was the lack of evidence that was found to support earlier studies suggesting that girls were more likely to use the Internet for social activities than boys (Brunner & Bennett, 1998; Hanor 1998). In this study, boys were found to use the

Internet more for social activities, such as e-mail, instant messaging, and chat rooms, than girls.

In addition, many girls, though less than boys, reported playing computer games in their spare time. This finding updates Becker and Sterling's (1987) research that found that boys were much more likely to play computer games in their spare time than girls.

Perceptions and opinions. Overall in this study, girls and boys reported the same positive opinions and perceptions of the Internet and computers. When asked to rank their computer abilities, no significant differences were found between the ways that girls ranked their skills as compared to boys. In addition, girls were also just as likely as boys to consider computers important to their future careers.

However, despite this finding, very few girls were taking the elective computer classes at Jane Lathrop Stanford Middle School. This finding supports earlier findings that, in elementary school through high school, girls were less likely to take computer courses than boys (Becker & Sterling, 1987).

Other findings suggest further reasons why more girls are not continuing with computer classes. Differences, although not statistically significant, were noted during the different stages of the study. During the observation stage, girls seemed more intimidated than boys by computers, girls tended to blame themselves when their computers broke down, and girls were observed to be less assertive than boys when asking for help in computer class. This finding supports earlier research that found that women act more helpless when using technology than men (Brunner & Bennett, 1998; Huber & Podsakoff, 1987).

During the focus groups, girls and boys reported some differences in the way they thought about computers and the Internet. Girls were more likely than boys to report that the Internet was not always the best place to go for information. Girls reported that that it took too long to find the information they needed on the Internet. Moreover, when it came to opinions about computers specifically, boys reported more favorable perceptions. More boys than girls agreed that computers are easier to use, and more boys than girls felt that computers helped them to be more creative.

Implications. Despite girls' positive attitudes towards computers and the Internet, girls at Jane Lathrop Stanford Middle School are not electing to take the more advanced computer classes. From the observation stage of this study, the researcher found that there are several reasons why this is the case. Other elective classes may be simply more appealing to girls. It may also be the way the introductory classes are taught at the school. Computer assignments were generally completed in a group format. It was observed that when girls were put in mixed gender groups, girls often let the boys take over direction of the machine. In addition, girls were less likely to get help in the computer lab than their male counterparts because of the format of the help request system. Girls may also be more concerned that computer classes will lower their grade point average when compared to boys.

In addition, it may be that girls are more impacted by the opinions of their peers. When students were asked if boys were naturally more skilled at computers than girls, more boys felt that boys were naturally more skilled than girls. This finding supports

Pearl et al.'s (1990) conclusion that society communicates that computers are not appropriate for women.

Limitations

The strength of this study is that it focuses on a segment of the young adolescent population where changes in opinions, perceptions, access, and use of new innovations is most likely to occur. However, as a consequence, the study was limited to one socioeconomic group in a geographic location that is more likely to promote the use of computers across all genders. The purposive sample is also a limitation since it may be that the girls who participated in the study may be more computer-savvy than girls who did not participate. In addition, this sample may not represent a trend for the population as a whole, given its unique location in Silicon Valley, the heart of the high tech industry in the United States. Therefore, a broader study needs to be conducted to determine if the apparent reduction in the gender gap is representative of the population as a whole. It is also important to determine if the patterns of usage for early adopters in this study can be replicated in another sample.

In addition, although girls and boys reported spending the same amount of time using computers and the Internet, this study did not take into account the student's previous experience using technology. From the observation stage of this study, it was clear that boys generally entered the classroom with more experience using computers than girls. These differences were most obvious when the students were observed in the computer class. Boys were observed knowing exactly where to go on-line and how to

find the information they wanted. They were also observed accessing recreational software using the school's computer network.

Contributions to the Literature

The results of this study are important for a number of reasons. It is one of the first studies to suggest that the computer gender gap in early adopter populations may be disappearing. It is also one of the first to combine computer gender gap research and the Internet and to determine whether there is differential Internet use between boys and girls.

This study also extends research on women and computers to the Internet. Previous research focused on girls' negative attitudes toward computers and technology; in this study, however, no gender differences were found. Boys' and girls' opinions and perceptions of computers and the Internet were the same and both considered them important to their future careers. Despite these positive results, girls were still less likely to take computer classes than their male classmates. This finding helps narrow the scope for future research, and suggests that positive perceptions and opinions may not be enough to get more women involved in the field of computer science.

Directions for Future Research

The quantitative results of this study suggest that in this early adopter population the gender gap in computer adoption is closing. The qualitative results suggest that, although girls and boys are using the computer and the Internet for the same amount of time, there are some interesting differences in the way that girls and boys use these technologies. During in the observation and focus group stages of this research, it was

found that boys were more likely than girls to use computers and the Internet for entertainment, whereas girls were more likely to use these technologies to get things done. This finding needs to be tested further using survey research to see if these differences are statistically significant and if they are found in the general population as a whole.

Second, looking at the impact of the Internet on computer perceptions and use is a fertile field for research. Further research that compares the types of sites visited by girls and boys would add to the literature in this field. Tracking actual usage time and categorizing the sites would also add more understanding to the type of information that young people look for on the Internet. Comparing Internet usage patterns to the way that young people use traditional forms of mass media, such as television and magazines, would help determine if the Internet is replacing old media or increasing the overall amount of time that people spend using the media in general.

Finally, although in this study girls' perception and use of computers were found to be similar to boys', more research is needed to determine why girls are still reluctant to take computer classes. Further research that looks into the culture of computer classrooms and the teaching texts could help determine if there are any inherent biases in the way information is presented to students. Wider cultural issues also need to be examined to determine where girls learn that computer science is not a field for them so that policies can be developed to attract more girls into the elective computer classes and to prepare them for a future career in the field.

REFERENCES

Attewell, Paul, & Battle, Juan (1999). Home computers and school performance. *The Information Society, 15*(1), 1-10.

Becker, Henry J. (1983). *School uses of microcomputers*. Baltimore, MD: John Hopkins University, Center for Social Organization of Schools.

Becker Henry, & Sterling, Carleton W. (1987). Equity in school computer use: National data and neglected considerations. *Journal of Educational Computing Research, 3*(3), 289-311.

Bellis, Mary (2000). *The history of modern computers and their inventors* [On-line]. Available: http://inventors.about.com/science/inventors/library/blcoindex.htm

Bergin, David A., Ford, Martin E., & Hess, Robert D. (1993). Patterns of motivation and social behavior associated with microcomputer use of young children. *Journal of Educational Psychology, 85*(3), 437-445.

Boutilier, Robert (1993). Pulling the families' strings. *American Demographics, 77*, 44-49.

Brunner, Cornelia, & Bennett, Dorothy (1998). Technology perceptions by gender. *The Education Digest, 63*, 56-58.

Butler, Deborah (2000). Gender, girls, and computer technology: What's the status now? *The Clearing House, 73*(4), 225-229.

California State Education Department (1999). *Palo Alto School District data* [On-line]. Available: http://data1.cde.ca.gov/dataquest/dataquest.asp

Collis, Betty (1985). Psychological implications of sex differences in attitudes toward computers: Results of a survey. *International Journal of Women's Studies, 8*, 207-213.

Computer use declines as girls' age. (1995, October 23). *USA Today*, p. 10.

Corcoran, Elizabeth (1999, February 8). Women's on-line ranks rise; As the sexes equalize on the Internet, patterns of usage emerge. *The Washington Post*, p. F19.

Corson, David (1992). Language, gender, and education: A critical review linking social justice and power. *Gender and Education, 4*(3), 229-254.

Culley, Lorraine (1988). Girls, boys, and computers. *Educational Studies, 14*(1), 3-8.

DeBare, Ilana (1996). Computer classes lack key feature: Girl's faces. Part 5: Women in the computer industry. Sacramento Bee [On-line]. Available: http://www.sacbee.com/news/projects/women/wcschools.html

Dern, Daniel P. (1994). *The Internet users' guide*. New York: McGraw Hill.

Dorman, Steve M. (1998). Technology and the gender gap. *The Journal of School Health, 68*(4), 165-166.

Dyrud, Marilyn A. (1997). An exploration of gender bias in computer clip art. *Business Communication Quarterly, 60*, 30-52.

Eastman Susan, & Krendl, Kathy (1987). Computers and gender: Differential effects of electronic search on students' achievement and attitudes. *Journal of Research and Development in Education, 20*(3), 41-48.

Edwards, Cliff (2000). *Study: Web economy doubled in 1999* [On-line]. Available: http: //www.associatedpress.com/technology.html

Fredman, Ann (1992). *Yes, I can: Action projects to resolve equity issues in educational computing*. Eugene, OR: International Society for Technology in Education.

Fiore, Catherine (1999). Awakening the tech bug in girls. *Learning and Leading with Technology, 26*, 10-17.

Frenkle, Karen A. (1990). Women and computing. *Communications of the ACM, 33*, 34-44.

Garrubbo, Gina (1998). What makes women click? *Advertising Age, 69*, 12-15.

Gutek, Barbara A., & Bikson, Tora K. (1985). Differential experiences of men and women in computerized offices. *Sex Roles, 13*, 123-136.

Hafner, Katie, & Lyon, Matthew (1996). *When wizards stay up late: The origins of the Internet*. New York: Simon and Schuster.

Hanor, Joan H. (1998). Concepts and strategies form women's interactions with computers. *Theory into Practice, 37*, 64-71.

Hanson, Kathy (1997). *Gender, discourse, and technology*. Working Paper 5, Newton, MA: Education Development Center.

Harris, Susan (1999). Secondary students' use of computers at home. *British Journal of Educational Technology, 30*(4), 331-339.

Hawkins, Jan (1985). Computers and women: Rethinking the issues. *Sex Roles, 13,* 165-180.

Hess, Robert D., & Miura, Irene T. (1985). Gender differences in enrollment in computer camps and classes. *Sex Roles, 13,* 193-203.

Hoyles, Celia (1988). *Girls and computers: Gender issues and case studies of Logo in the mathematics classroom.* London, UK: University of London.

Hsia, Hower J. (1988). *Mass communications research methods: A step-by-step approach.* Hillsdale, NJ: Lawrence Erlbaum.

Huber, Vandra L., & Podsakoff, Phillip M. (1987). Dispositional and situational moderators of female and male causal attributions. *Sex Roles, 13,* 441-461.

Huff, Charles W., & Cooper, Joel (1987). Sex bias in educational software: The effect of designers' stereotypes on the software they design. *Journal of Applied Psychology, 17,* 519-532.

Jane Lathrop Stanford Middle School (1998). *Report to the Community* [On-line]. Available: http://www.jls.palo-alto.ca.us/

Keisler, Sara, Sproull, Lee, & Eccles, Jacqueline S. (1985). Pool halls, chips and war games: Women in the culture of computing. *Psychology of Women Quarterly, 9,* 451-462.

Kohlberg, Lawrence (1966). A cognitive developmental analysis of children's sex-role concepts and attitudes. In Eleanor Maccoby (Ed.), *The development of sex differences* (pp. 82-173). Stanford, CA: Stanford University Press.

Libert, Robert, McCall, Richard, & Hanratty, Michael (1971). Effects of sex-typed information on children's toy preferences. *Journal of Genetic Psychology, 119,* 133-136.

Lindlof, Thomas R. (1995). *Qualitative communication research methods.* Thousand Oaks, CA: Sage Publications.

Linn, Marcia C. (1985). Fostering consequences from computer learning environments. *Sex Roles, 13,* 229-240.

Mark, James, & Hanson, Kathy (1992). Beyond equal access: Gender equity in learning computers. Newton, MA: Educational Development Center.

Martinez, Martin, & Mead, Nora A. (1988). *Computer competence: The first national assessment*. Princeton, NJ: National Assessment of Educational Progress at Educational Testing Service.

McWilliams, Gary (1999). Are PC sales slowing down? *The Wall Street Journal Interactive Edition* [On-line]. Available: http://www.zdnet.com/zdnn/stories/news/0,4586,2217858,00.html

Media Metrix and Jupiter Communications (2000). *It's a women's World Wide Web,* [On-line]. Available: http://www.mediametrix.com/pressroom/mmxarchives/data11_16_98b.html

Morgan, Janice (1997). *Community ties and a community network.* Unpublished master's thesis, San Jose State University, San Jose, California.

Ms. Net: Statistics on female Internet users. (1998). *The Progressive Grocer, 77,* 1.

Newman, Leonard S., Cooper, Joel, & Ruble, Diane N. (1995). Gender and computers: The interactive effects of knowledge and constancy on gender-stereotyped attitudes. *Sex Roles, 33,* 325-351.

Nicholson, Jukliw, Gelphi, Adrienne, Young, Shannon, & Sulzby, Elizabeth (1998). Influences of gender and open-ended software on first graders' collaborative composing activities on computers. *Journal of Computing in Childhood Education, 9,* 3-42.

Okebukola, Peter A. (1993). The gender factor in computer anxiety and interest among some Australian high school students. *Educational Research, 35*(2), 181-189.

Palo Alto by numbers. (2000). *Palo Alto Daily On-Line* [On-line]. Available: http://www.paloaltoon-line.com/paw/paon-line/com_info/by_the_numbers.html

Pearl, Amy, Pollack, Martha, Riskin, Eve, Thomas, Becky, Wolf, Elizabeth, & Wu, Alice (1990). Becoming a computer scientist: Report by the ACM Committee on the Status of Women in Computing Science. *Communications of the ACM, 33,* 47-58.

Plotkinoff, David (1995, October 12). Measuring the net is a tricky task: Counting surfers isn't easy. *San Jose Mercury News,* pp. 1E, 10E.

Proctor, Romina M., & Burnett, Paul C. (1996). Computer attitude and classroom computers. *Computers in Schools, 12*(3), 33-41.

Rheingold, Howard (1993). *The virtual community: Homesteading on the Internet* [On-line]. Available: http://www.well.com/user/hlr/vcbook/vcbook3.html

Rocheleau, Bruce (1995). Computer use by school-age children: Trends, patterns, and predictors. *Educational Computing Research, 12*(1), 1-17.

Rogers, Everett M. (1995). *The diffusion of innovations* (4th ed.). New York: Simon & Schuster.

Rogers, Everett M., Daley, Hugh M., & Wu, Thomas D. (1982). *The diffusion of home computers: An exploratory study.* Unpublished report for the Institute of Communication Research, Stanford University.

Ryckman, David, & Peckham, Percy (1987). Gender differences in attributions for success and failure. *Journal of Early Adolescence, 7*, 47-63.

Sanders Jan (1985). Here is how you can help girls take greater advantage of school computers. *American School Board Journal, 172*, 37-38.

Sanford, Glen (2000). *The history of Apple computers* [On-line]. Available: http://www.apple-history.com/history.html

Sheingold, Karen (1981). *Issues related to the implementation of computer technology in schools: A cross-sectional study.* Paper presented at the NIE Conference in Issues Related to the Implementation of Technology in Schools, Washington, DC.

Solsken, Judith W. (1993). Literacy, gender, and work: In families and in school. Norwood, NJ: Ablex.

Span, Phillip (1994, February 27). On-line mystique. *The Washington Post On-line* [On-line]. Available: http://www.washingtonpost.com

Stephens, Mitchell (1998). Which communication revolution is it anyway? *Journalism and Mass Communication Quarterly, 75*, 9-13.

Strangelove, Michael (1994). The Internet as catalyst for a paradigm shift. *Computer Mediated Communication Magazine* [On-line]. Available: http://www.december.com/cmc/mag/1994/dec/shift.html

Sutton, Rosemary E. (1991). Equity and computers in schools: A decade of research. *Review of Educational Research, 61*, 475-503.

Swadener, Marc, & Jarrett, Karen (1986). Gender differences in middle grade students' actual and preferred use. *Educational Technology, 26*, 42-47.

Tichenor, Phillip J., Donohue, George, & Olien, Clarice N. (1970). Mass media flow and differential growth in knowledge. *Public Opinion Quarterly, 34*, 159-170.

Times Mirror (1994). *Technology and the American household.* Los Angeles, CA: Times Mirror Center for the People and the Press.

The UCLA Internet Report, (2000). *Surveying the digital future* [On-line]. Los Angeles: Center for Communication Policy. Available: http://www.ccp.ucla.edu

United States Census Bureau (1994). *Statistical brief: Who uses computers?* [On-line]. Washington, DC: Kominski, Robert. Available: http://www.census.gov/population/socdemo/computer/sb88-2.pdf

United States Census Bureau (1997). *Computer use in the United States* [On-line]. Washington, DC: Newburger, Eric. Available: http:// www.census.gov/population/www/socdemo/computer.html

United States Census Bureau (1999). *Access denied: Changes in computer ownership and use: 1984-1997* [On-line]. Washington, DC: Kominski, Robert, & Newburger, Eric. Available: http:// www.census.gov/population/www/socdemo/computer.html

Wilder, Gita, Mackie, Diane, & Cooper, Joel (1985). Gender and computers: Two surveys of computer-related attitudes. *Sex Roles, 13*, 215-228.

Wimmer, Roger D., & Dominick, Joseph R. (1991). *Mass media research: An introduction* (3rd ed.). Belmont, CA: Wadsworth.

Wright, Charles Robert (1986). *Mass communication: A sociological perspective.* New York: Random House.

APPENDICES

Appendix A

Palo Alto Unified School District
25 Churchill Avenue Palo Alto, California 94306

Barbara Liddell

November 16, 1999

Cate Humby-Hoff
4144 Park Blvd.
Palo Alto, CA 94306

Dear Ms. Humby-Hoff.

I have reviewed your proposal to conduct a research study related to gender differences in computer use, with particular focus on how girls use the Internet. Your project falls within the guidelines established by the District for research in our schools. Therefore, you have permission to proceed pending the consent of Joy Addison, Principal – Jane Lathrop Middle School, and any other staff who would be involved in the project.

Good luck with your research.

Sincerely,

Barbara Liddell

Barbara Liddell, Associate Superintendent
EDUCATIONAL SERVICES

Appendix B

Survey of Students at Jane Lathrop Stanford Middle School

COMPUTERS & THE INTERNET

>> Please put a check next to the appropriate answers below.

1. Do you have a computer of your own at home? (If yes, please skip to question 3)

Yes_____ No_____

2. How many people do you share your computer with?

_____ People

3. Where is the computer you use located?

Family room____ My bedroom____ Another bedroom____

Kitchen ____ Parent's home office ____ Other (please state) _____

4. Do you know more about computers than your parents?

Yes_____ No_____

5. Do you need to ask permission to use the Internet at home?

Yes_____ No_____

6. Are you allowed to surf the Internet when your parents are not around?

Yes_____ No_____

7. Do your parent's check up on what Internet sites you visit?

Yes_____ No_____

>> Please turn over the page

>> Please fill in the number of hours you spend doing the activities below in an average week. If your answer is zero, please write "0" in the space provided.

8. In an average week, how many hours a week do you use a computer at school and at home?

_____ hours

9. In an average week, of the time you spend on the computer, how many hours are on the Internet?

_____ hours

10. In an average week, how many hours a night do you spend doing homework?

_____ hours

11. Of the total time you spend doing homework, how much of it is spent using the Internet?

_____ hours

12. Of the total time you spend on your computer for school AND fun, please indicate roughly the percent of time you spend doing the following activities: (*Please note that your responses should range from 0-100% and the total should not exceed 100%)

Sending e-mail and instant messages to my friends _____%

Typing up papers for school _____%

Using graphics programs _____%

Surfing the Internet _____%

Using chat rooms _____%

Playing games _____%

Shopping _____%

Other (please state) _____%

13. I search the Internet for information on the following topics: (Please put a check next ALL the answers that apply to you)

____ Sports ____ Topics for school assignments ____New products

____My favorite celebrities ____The latest news ____Computer games

____The latest technologies ____ Beauty & fashion trends

Other (please state)_____

14. Where do you learn about computers? If you learn from more than one source, please rank your sources with 1 indicating the most useful source, 2 the next most useful source, etc.

Friends ____ My mom ____ My dad ____ My school ____

From information I find on the Internet ____ From reading manuals ____

From experimenting on my computer ____ Other (please state)_____

15. Below are some statements about the Internet and computers. Please indicate if you strongly agree, agree, neither agree or disagree, disagree or disagree strongly with each of these statements.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
It is difficult to find things on the Internet					
Learning about the Internet is not a priority for me					

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Surfing the Internet is one of the most important activities I do in my spare time					
Only people who want to work in the technology industry need to care about computers					
I usually blame myself when my computer crashes					
I rarely find any interesting information on the Internet					
Keeping up with the latest technologies is important to me					
I consider myself to be on the cutting edge of technological advances					
Surfing the Internet is a waste of my precious time					
I always find information that interests me on the Internet					
I have plenty of spare time to explore the Internet					
There is nothing on the Internet that interests me					
I don't have enough time to surf the Internet					

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I always get lost when looking up information on the Internet					
Knowing about computers is very important to my future career					
It is more important for boys to learn about computers than girls, as boys need this knowledge to help them earn a living to support a family					
Computers are not important to my future profession					

16. How would you rate your computer skills on a scale from 0 to 100? 0 is poor and 100 is excellent. Please mark the line where appropriate.

0	50	100
No computer skills	Average skills	Super skills

17. Please indicate on a scale from 0 to 100 your interest and ability in doing the following:

0	50	100
No interest/ability	Average interest/ability	Super interest/ability

	INTEREST	ABILITY
Using a word processing program, such as Microsoft Word	_____	_____
Using spreadsheet programs like Excel	_____	_____
Sending e-mail and instant messages	_____	_____
Using a search engine, such as yahoo	_____	_____

	INTEREST	ABILITY
Accessing web sites for which I have an address	_____	_____
Following a link from one web site to another	_____	_____
Saving a bookmark for a website	_____	_____
Installing software programs	_____	_____
Fixing my computer	_____	_____
Installing new memory in my hard drive	_____	_____

18. Below are some statements about the Internet and computers. Please indicate if you strongly agree, agree, neither agree or disagree, disagree or disagree strongly with each of these statements.

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Using computers is very easy for me					
The last thing I want to do in my spare time is sit down in front of a computer					
My parents don't care what sites I visit on the Internet					
The computer classes at JLS are too easy					
I only go to the web sites that my parents approve of					
There are no computer classes at JLS that interest me					
I can go wherever I want on the Internet					

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Computers help me to be creative					
The computer classes at JLS are too difficult					
I learn about new web sites from other people					
I don't like computers because they don't allow me to be creative					
I learn about new web sites from magazines					
My friends tell me what sites to visit on the Internet					
Boys are naturally more skilled at using computers than girls					
The Internet is boring					
Computers are frustrating					
It is hard to find the information I need on the Internet					
It is more important that boys know about computers than girls, as boys are more likely to work in the technology industry					
The most enjoyable activity on computers is drawing pictures					

Demographics

19. Which computer classes have you taken at JLS? (Please put a check next to all the classes you have taken or are currently enrolled in)

Keyboarding _____ Web Design _____ Computer programming _____

20. How old are you? _____years old.

21. What is your gender? Male_____ Female_____

22. If you were born outside of the United States, please state the country of your birth

_____

23. Is English your first language? Yes_____ No_____

24. If no, what is your first language? _____

THANK YOU FOR TAKING THE TIME TO ANSWER THESE QUESTIONS

PLEASE RETURN COMPLETED SURVEYS TO THE ADMINISTRATIVE OFFICES IMMEDIATELY